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ESCHWEILER & ASSOCIATES, LLC
NATIONAL CITY BANK BUILDING
629 EUCLID AVE., SUITE 1210
CLEVELAND, OH 44114

EXAMINER	
HOANG, ANN THI	
ART UNIT	**PAPER NUMBER**
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/642,939	KELLERMAN ET AL.
	Examiner	Art Unit
	Ann T. Hoang	2836

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 18 August 2003.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-47 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-47 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 8/18/03, 9-11-03. 1/25/05
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities: On page 12, line 10, electrostatic chuck 100 should be referenced with numeral 10. On page 23, line 19, second electrically conductive layer 145 should be referenced with numeral 165. On page 26, the paragraph beginning on line 19 refers to lift pins 210 in Fig. 8. Lift pins 210 are not shown in Fig. 8, but in Fig. 11.

Appropriate correction is required.

Claim Objections

2. Claim 16 is objected to because of the following informalities: In line 3, the meaning of "...therein substantially cooling the plurality of base plate" is unclear. For the purposes of this action, Examiner will read claim 16 as "...therein substantially cooling the base plate." Appropriate correction is required.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

4. Claim 1 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4, 12, 29 and 35 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because a multi-polar electrostatic chuck for clamping a substrate and controlling a heat transfer associated therewith, the electrostatic chuck comprising: a clamping plate, the clamping plate further comprising: a semiconductor platform; a first electrically conductive layer formed over a top surface of the semiconductor platform, wherein the first electrically conductive layer comprises a plurality of portions, wherein the plurality of portions are generally electrically isolated from one another, therein defining a plurality of poles associated with the electrostatic chuck; and a plurality of electrically insulative protrusions formed over the first electrically conductive layer, the plurality of protrusions extending a first distance from a top surface of the first electrically conductive layer; and a plurality of electrodes electrically connected to the respective plurality of portions of the first electrically conductive layer, wherein the plurality of electrodes are further operable to be

connected to a voltage source is encompassed by the language of claim 1 of the patent. It is inherent that the voltage is applied via a plurality of electrodes, as would be required to energize a plurality of portions of different poles. Claim 35 of the patent discloses that the plurality of protrusions is operable to generally contact the substrate, therein defining a protrusion contact area. The plurality of protrusions would inherently define a plurality of gaps therebetween having a second distance associated therewith, as claim 29 refers to these as a plurality of valleys. Claim 12 of the patent discloses a base plate operable to transfer thermal energy from the semiconductor platform to the base plate, during which the same thermal energy would inherently be transferred from the substrate through the clamping plate as well.

5. Claims 2-3 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4, and 6 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other for the following reasons:

Regarding claim 2, claims 4 and 6 of the patent disclose a second electrically conductive layer, the second electrically conductive layer comprising a plurality of vertical interconnects and a plurality of portions formed over a bottom surface of the semiconductor platform, wherein the plurality of portions of the second electrically conductive layer are generally electrically isolated from one another, wherein the second electrically conductive layer is electrically connected to the first electrically conductive layer through the plurality of vertical interconnects, and wherein the plurality

of electrodes are electrically connected to the respective plurality of portions of the second electrically conductive layer.

Regarding claim 3, the plurality of vertical interconnects extending through the semiconductor platform from the top surface, or the first electrically conductive layer, to the bottom surface, or the second electrically conductive layer, can be interpreted to be a plurality of vias, as the definition of a via is simply a plated-through hole with interconnects for conductors on different sides or layers of a circuit board.

6. Claims 4 and 14 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4, 6 and 7 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because of the following:

Regarding claim 4, claim 7 of the patent discloses that the plurality of vertical interconnects are generally formed on a sidewall of the semiconductor platform. It is inherent that the plurality of vertical interconnects are electrically connected to the respective plurality of electrodes, as the vertical interconnects are electrically connected to the plurality of portions of the electrically conductive layers, which are electrically connected to a plurality of electrodes.

Regarding claim 14, the language of claim 7 of the patent discloses a plurality of sidewall contacts, or interconnects, generally formed on a sidewall of the semiconductor platform and the first electrically conductive layer being connected to the electrodes via the sidewall interconnects.

7. Claims 6, 8 and 12 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4, 12, 13 and 15 of U.S. Patent No. 6,946,403.

Regarding claim 6, claim 13 of the patent discloses the base plate comprising a third electrically conductive layer formed thereon, wherein the third electrically conductive layer further comprises a plurality of portions electrically isolated from one another, wherein the plurality of portions of the third electrically conductive layer are electrically connected to the respective plurality of portions of the second electrically conductive layer. Claim 15 of the patent discloses the base plate having an oxide layer formed over the base plate and under the third electrically conductive layer. Although the conflicting claims are not identical, they are not patentably distinct from each other because oxides are generally not conductive to electricity, therefore the oxide layer of the patent would constitute the first electrically insulative layer of claim 6.

Regarding claims 8 and 12, claim 15 of the patent discloses the base plate comprising an amorphous silicon plate.

8. Claim 9 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4, 12, 13, and 16 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 16 of the patent discloses the third electrically conductive layer comprising one or more of tungsten silicide, tungsten, or titanium.

9. Claim 11 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4, 12, 13, and 14 of U.S. Patent

No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 13 of the patent discloses that that the base plate comprises a third electrically conductive layer having a plurality of electrically isolated portions, and therefore can be interpreted to be generally electrically conductive with a plurality of electrically isolated segments. The language of claims 13-14 of the patent indicates that the plurality of portions of the second electrically conductive layer are electrically connected to that of the third electrically conductive layer in the base plate and that these portions are furthermore connected to a plurality of electrodes.

10. Claim 13 rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4 and 11 of U.S. Patent No. 6,946,403. Claim 11 of the patent discloses the second electrically conductive layer comprising one or more of tungsten silicide, tungsten, or titanium.

11. Claim 16 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4, 12, and 20 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 20 of the patent discloses the base plate further comprising one or more fluid conduits, wherein a cooling fluid is operable to flow through the fluid conduits, therein substantially cooling the plurality of base plate.

12. Claim 17 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4, 12, and 18 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 18 of the patent discloses that the base plate is

vacuum brazed to the clamping plate, since the second electrically conductive layer forms the bottom side of the clamping plate.

13. Claim 18 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 22 of U.S. Patent No. 6,946,403. Claim 22 of the patent discloses the first electrically conductive layer comprising one or more of tungsten silicide, tungsten, or titanium.

14. Claim 24 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 23 of U.S. Patent No. 6,946,403. Claim 23 of the patent discloses the semiconductor platform comprising silicon.

15. Claim 25 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 24 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 1 of the patent discloses that the first electrically insulative layer comprising a plurality of protrusions and claim 24 of the patent discloses the first electrically insulative layer comprising silicon dioxide. Therefore, the plurality of protrusions must comprise silicon dioxide.

16. Claim 27 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 39, and 42 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 42 of the patent discloses the plurality of

portions of the first electrically conductive layer being generally electrically isolated from one another by an electrically insulative insert.

17. Claim 28 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 29, and 31 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 31 of the patent discloses a protective layer formed over the first electrically insulative layer, which comprises the plurality of protrusions. Therefore, there is a protection layer formed over the protrusions.

18. Claims 30 and 32 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 1 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because of the following reasons:

Regarding claim 30, claim 1 of the patent discloses that the plurality of protrusions comprise an array of micro-electromechanical (MEMS) structures.

Regarding claim 32, claim 1 of the patent discloses the electrostatic chuck further comprising a voltage control system operable to control a voltage to the plurality of poles, and therefore the plurality of electrodes, from the voltage source, wherein the voltage is operable to induce an electrostatic force in the clamping plate, and therefore between the clamping plate and the substrate, therein selectively clamping the substrate to the clamping plate.

19. Claim 39 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 35 and 36 of U.S. Patent No.

6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 35 of the patent discloses the ratio of the protrusion contact area to a surface area of the substrate falling between about 0.02 and 0.2, 0.1 or more being in this range. Claim 36 of the patent further specifies the ratio as being approximately 0.1.

20. Claim 40 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 4 and 12 of U.S. Patent No. 6,946,403. Although the conflicting claims are not identical, they are not patentably distinct from each other because claim 12 of the patent discloses that the base plate is thermally coupled to the second electrically conductive layer, which forms the bottom surface of the clamping plate.

21. Claim 41 is rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 and 37 of U.S. Patent No. 6,946,403. Claim 37 of the patent discloses the first distance to be approximately 1 micron.

Claim Rejections - 35 USC § 103

22. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

23. Claims 1-3, 6, 16-17, 19, 21, 24, 27-30, 32 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834).

Regarding claim 1, Logan et al. teaches a multi-polar electrostatic chuck 40 for clamping a substrate (not shown, see column 2, lines 56-57) and controlling a heat transfer associated therewith, the electrostatic chuck comprising: a clamping plate, the clamping plate further comprising: a first electrically conductive layer 45, wherein the first electrically conductive layer comprises a plurality of portions, wherein the plurality of portions are generally electrically isolated from one another, therein defining a plurality of poles associated with the electrostatic chuck; and a plurality of electrically insulative protrusions (42, 46) formed over the first electrically conductive layer, the plurality of protrusions extending a first distance from a top surface of the first electrically conductive layer, and wherein the plurality of protrusions generally define a plurality of gaps therebetween having a second distance associated therewith; a base plate (60, 70) operable to transfer thermal energy from the substrate through the clamping plate; and a plurality of electrodes electrically connected to the respective plurality of portions of the first electrically conductive layer, wherein the plurality of electrodes are further operable to be connected to a voltage source. See abstract and Fig. 1. Electrostatic chuck 40 is multi-polar, as protrusions (42, 46) are alternately energized with opposite DC potentials, as disclosed in column 2, lines 64-68 and column 3, lines 1-3. First electrically conductive layer 45 is divided into a plurality of electrically isolated portions of a plurality of poles by vertical interconnects 48. The

description of background art of the reference discloses polarized electrodes as being common in the art (column 1, line 25). The reference discloses the method of providing electrical energy, or a voltage source, to vertical interconnects 48 by such electrodes. Since vertical interconnects 48 are running through the plurality of portions of first electrically conductive layer 45, said portions are electrically connected to said electrodes. The bottom portion of base plate (60, 70) acts as a heat sink for providing thermal conductivity or thermal isolation to electrostatic chuck 40.

Logan et al. does not disclose a semiconductor platform as one of the layers in electrostatic chuck 40. However, Weldon et al. discloses an electrostatic chuck 100 comprising multiple layers 115 of semiconductor material. See Fig. 3a and column 20, lines 58-60. Weldon et al. emphasizes the physical properties of semiconductor material 115 being critical to the operation of electrostatic chuck 100, i.e. charging and discharging response time and chucking and dechucking speed due to the resistance of the material. It would have been obvious to one of ordinary skill in the art at the time of the invention to include the semiconductor platform of Weldon et al. as the layer under the first electrically conductive layer in the electrostatic chuck of Logan et al. in order provide a processing environment adaptive to the physical properties of the semiconductor wafer under process. For example, an electrostatic chuck comprising a layer of semiconductor material similar to the semiconductor material of the wafer under process would have similar physical properties (resistance, heat tolerance, etc.) to that of the wafer under process and would provide a more ideal processing environment.

Regarding claim 2, Logan et al. discloses the clamping plate further comprising a second electrically conductive layer 52, the second electrically conductive layer 52 comprising a plurality of vertical interconnects (56, 58) and a plurality of portions, wherein the plurality of portions of the second electrically conductive layer are generally electrically isolated from one another, wherein the second electrically conductive layer 52 is electrically connected to the first electrically conductive layer 45 through the plurality of vertical interconnects (56, 58). See Fig. 1. Second electrically conductive layer 52 is shown as being under first electrically conductive layer 45. In the electrostatic chuck of Logan et al. in view of Weldon et al., the semiconductor plate would be placed between the first and second electrically conductive layers (see above rejection). Therefore, the second electrically conductive layer would be formed over a bottom surface of the semiconductor platform. Since the vertical interconnects (56, 58) are running through the plurality of portions of second electrically conductive layer 52, the plurality of portions of second electrically conductive layer 52 must be electrically connected to the plurality of electrodes.

Regarding claim 3, Logan et al. discloses the plurality of vertical interconnects (48, 56, 58) comprising a plurality of vias generally extending through the first and second electrically conductive layers 48 and 52. See Fig. 1. The electrically conductive layers 48 and 52 would respectively form the top and bottom surfaces of the semiconductor platform in the combination of Logan et al. in view of Weldon et al. (see above rejections). Therefore, the plurality of vias (48, 56, 58) would extend through the semiconductor platform from the top surface to the bottom surface.

Regarding claim 6, Logan et al. discloses base plate (60, 70) comprising a first electrically insulative layer 62 and a third electrically conductive layer 72, and wherein the first layer electrically insulative layer 62 further comprises a plurality of portions electrically isolated from one another (via vertical interconnects 64), wherein the plurality of portions of the third electrically conductive layer are electrically connected to the respective plurality of portions of the second electrically conductive layer. See Fig. 1. First electrically insulative layer 62 is a boron nitride substrate (column 3, line 46-47), which is generally nonconductive at room temperatures. Third electrically conductive layer 72 forms a heat sink base 70. Heat sinks are commonly made of copper or aluminum, highly conductive metals.

In electrostatic chuck 40 of Logan et al., first electrically insulative layer 62 is formed above third electrically conductive layer 72. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to form the third electrically conductive layer above the first electrically insulative layer, so that the first electrically insulative layer resided between the base plate and the third electrically conductive layer, in order to place the heat sink portion of the base plate closer to the wafer under process and therefore absorb the heat generated in the upper portion of the chuck sooner. In this case, vertical interconnects (48, 58) would have to extend through and divide into portions third electrically conductive layer 72 in order to reach vertical interconnects 64 of first electrically insulative layer 62, and the portions of third electrically conductive layer 72 would be electrically connected to the respective portions of second electrically conductive layer 52.

Regarding claim 16, Logan et al. discloses base plate (60, 70) further comprising one or more fluid conduits 78, wherein a cooling fluid is operable to flow through fluid conduits 78, therein substantially cooling the base plate. See Fig. 1 and column 3, lines 62-64.

Regarding claims 17 and 40, Logan et al. discloses heat sink base 70 to be thermally coupled, particularly brazed, to the layers above it. See column 5, lines 14-16.

Regarding claim 19, Logan et al. discloses base plate (60, 70) to comprise a heat sink base 70, wherein the clamping plate is electrically insulated from heat sink base 70 via first electrically insulating layer 60. See Fig. 1. Heat sink base 70 is not explicitly specified to be formed of an electrically conductive material. However, heat sinks are generally formed of metal, which are electrically conductive.

Regarding claim 21, Logan et al. discloses an intermediate plate 60, wherein intermediate plate 60 is the top layer of base plate (60, 70) and acts to electrically insulate the clamping plate from the lower portion of base plate (60, 70).

Regarding claim 24, Weldon et al. discloses that semiconductor platform 115 may comprise a number of semiconductor materials, including silicon, specifically silicides or silicon carbide (column 20, lines 38-45).

Regarding claim 27, Logan et al. does not disclose the plurality of portions of the first electrically conductive layer to be generally electrically isolated from one another by an electrically insulative insert.

However, Weldon et al. discloses an electrically insulative insert 610, one of many different embodiments, for insertion through layers of chuck 100 (see Fig. 8d and column 12, lines 61-67). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the insulative inserts of Weldon et al. to separate the plurality of portions of the first electrically conductive layer of Logan et al. in order to provide a removable electrical separation between the portions.

Regarding claim 28, Logan et al. discloses each of the plurality of protrusions (42, 46) comprising a protection layer 42 formed thereover. See Fig. 1 and abstract.

Regarding claim 29, Logan et al. does not specify that protection layer 42 comprises silicon nitride. However, the reference discloses that protection layer 42 may be fabricated from electrically insulative, thermally conductive, dielectric materials with thermal-mechanical characteristics compatible with boron nitride (see column 3, lines 6-18). Silicon nitride has these features and is commonly used as an insulator in the art. It would have been obvious to one of ordinary skill in the art at the time of the invention to use silicon nitride for making the protection layer 42 in order to provide an electrically insulative and thermally conductive isolation between the plurality of portions and wafer under process.

Regarding claim 30, the plurality of protrusions (42, 46) of Logan et al. comprises an array of micro-electromechanical structures 46. Protrusions of this type (in semiconductor technology) are generally mechanical components on the micrometer or millimeter size and have dominant electrostatic surface effects.

Regarding claim 32, Logan et al. discloses applying a voltage to the plurality of protrusions (42, 46) via vertical interconnects (56, 58), but does not disclose a voltage control system.

However, Weldon et al. discloses a voltage control system 120. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the voltage control system of Weldon et al. for the electrostatic chuck of Logan et al. in order to controllably provide a voltage to the plurality of electrodes and induce an electrostatic force between the clamping plate and the substrate, therein selectively clamping the substrate to the clamping plate.

24. Claims 4, 7, 11 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) as applied to claims 1-2 above, and further in view of Husain (5,880,922).

Regarding claim 4, Logan et al. discloses the plurality of vertical interconnects (48, 56, 58) suited to be electrically connected to the respective plurality of electrodes (column 1, line 25 and column 2, lines 61-63). Neither of the above references disclose a plurality of vertical interconnects as being generally formed on a sidewall of electrostatic chuck 40.

However, Husain discloses an outer electrode 9b that is along the sidewall (or outer edge) of an electrostatic chuck 1. Husain also discloses a plurality of electrical feedthrough openings 34 near the outer edge of the chuck discs that are filled with a conductive material for supplying a voltage to a plurality of electrodes. It would have been obvious to one of ordinary skill in the art at the time of the invention to move the

vertical interconnects of Logan et al. to the sidewall of the electrostatic chuck and apply voltage electrodes there in order to apply a voltage to each layer of the chuck while providing easy accessibility to the voltage electrodes for testing and troubleshooting.

Regarding claim 7, Fig. 1 indicates that part of third electrically conductive layer 72 generally resides along a sidewall of base plate (60, 70). It would also constitute the top surface of the base plate if layer 72 was formed above layer 62 (see above rejection). It would have been obvious to one of ordinary skill in the art at the time of the invention to electrically connect the plurality of portions of the third electrically conductive layer to the respective portions of the second electrically conductive layer via electrical feedthrough openings and vertical interconnects along the sidewall of the base plate for the same reasons above.

Claim 11 is rejected under the same reasoning as that of claims 6 and 7 (see above rejections).

Claim 14 is rejected under the same reasoning as that of claim 4 (see above rejection). It would be obvious and necessary to install sidewall interconnects for applying a voltage to vertical interconnects along the sidewall of the chuck, in order to supply a voltage to the plurality of layers in the chuck.

25. Claims 5 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) and Husain (5,880,922) as applied to claims 4 and 14 above, and further in view of Ma (US 2002/0173059).

Regarding claim 5, Logan et al. does not disclose a plurality of electrodes

comprising a respective plurality of spring-forced sidewall contact electrodes, wherein the plurality of spring-forced sidewall contact electrodes are operable to electrically contact the respective plurality of vertical interconnects. Husain does not disclose outer electrode 9b to comprise a spring-forced sidewall contact electrode.

However, Ma discloses an electromagnetic chuck assembly 300 with a spring-forced contact electrode 403 operable to electrically connect a voltage measurement circuit 418 to a substrate 401. A spring-loaded mechanism 416 containing spring-forced contact electrode 403 transmits a voltage from one end to the other. See Fig. 4 and page 3, paragraph [0046]. It would have been obvious to one of ordinary skill in the art at the time of the invention to use a plurality of spring-forced contact electrodes similar to that of Ma to electrically contact a respective plurality of vertical interconnects along the sidewall of the electrostatic chuck, such as that of Husain, thereby making them spring-forced sidewall contact electrodes. Electrodes connected to the sidewall of the chuck in a spring-forced connector assembly would allow easy access for testing, removal, and replacement. In addition, the electrical connection of a voltage source would be more easily visible as opposed to electrodes positioned within the layers of the chuck.

Claim 15 is rejected under the same reasoning as that of claim 5 (see above rejection).

26. Claims 8 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) as applied to claims 6 and 19 above, and further in view of Koltuniak et al. (US 3,566,959).

Regarding claim 8, Logan et al. does not disclose the material of which base plate (60, 70) is composed. However, the reference discloses layer 70 to be a heat sink base (see abstract). Heat sinks are commonly made of a good thermal conductor such as copper or aluminum. This is well known in the art, as Koltuniak et al. discloses a heat sink 12 made of aluminum and mounted on a copper bus bar 14 for support (see abstract). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to make the base plate out of copper or aluminum in order to have good thermal conductivity in the base plate.

Claim 20 is rejected under the same reasoning as that of claim 8 (see above rejection).

27. Claims 9, 13 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) as applied to claims 2 and 6 above, and further in view of Ehlert et al. (US 4,788,627).

Regarding claim 9, Logan et al. does not disclose third electrically conductive layer 72 to comprise one or more of tungsten silicide, tungsten, or titanium. However, the reference discloses layer 72 to be part of heat sink base 70. It is advantageous and well known in the art to use tungsten for heat sinks because of its hardness, density, and high melting point, as Ehlert et al. discloses a heat sink comprising tungsten (see abstract). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to make the third electrically conductive layer out of tungsten in order to have the physical properties advantageous for a heat sink as described above.

Regarding claim 13, Logan et al. discloses second electrically conductive layer 52 to act as a heating layer (see abstract), which would require it to be thermally conductive, just like heat sink base 70. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use tungsten for this purpose (see above rejection on claim 9). Additionally, it would have been obvious to one of ordinary skill in the art at the time of the invention to make this conductive layer the same material as that of other conductive layers in the chuck, such as the heat sink base, in order to provide a more uniform processing environment (i.e. consistent thermal expansion between layers). It is well known in the art to be consistent in the materials used to form multiple layers in semiconductor devices in order to avoid warping, etc. as a result of different physical properties of the materials and their reaction to heat.

Regarding claim 18, Logan et al. does not disclose first electrically conductive layer 45 to comprise one or more of tungsten silicide, tungsten, or titanium. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to make this conductive layer the same material as that of other conductive layers in the chuck. See above rejection on claim 13.

28. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) as applied to claim 6 above, and further in view of Nakajima (US 6,452,775). Logan et al. does not disclose first electrically insulative layer 62 to comprise silicon dioxide, but a boron nitride substrate.

However, using silicon dioxide as an electrical barrier in semiconductor devices

is well known in the art, as Nakajima discloses an electrostatic chuck with an insulation layer formed of silicon dioxide. See abstract. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to form the first electrically insulative layer of Logan et al. out of silicon dioxide for high quality insulator characteristics.

29. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) and Husain (5,880,922) as applied to claim 11 above, and further in view of Koltuniak et al. (US 3,566,959). The claim is rejected under the same reasoning as that of claim 8 (see above rejection).

30. Claims 22-23, 31, 33, 35-39 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) as applied to claims 1 and 21 above, and further in view of Mountsier et al. (US 5,810,933).

Regarding claim 22, Logan et al. discloses intermediate plate 60 to be metallized on a bottom surface thereof. Gold contact pads 82 are deposited on the bottom bonding surface of intermediate plate 60. The reference does not disclose intermediate plate 60 to comprise an aluminum nitride insulator wafer or to be metallized on the top surface.

However, it is well known in the art to use aluminum nitride as an electrical insulator, as disclosed by Weldon et al. (column 8, lines 39-45) and Mountsier et al. (column 4, lines 23-24). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to form intermediate plate 60 out of aluminum

nitride in order to simultaneously provide an electrical barrier and preserve heat conductivity between the clamping plate from the base plate, since the intermediate plate functions to electrically insulate the clamping plate from the heat sink base.

Additionally, it would have been obvious to one of ordinary skill in the art to metallize the top surface of the intermediate plate in order to provide a means for brazing the intermediate plate to another layer above it as well as below it. See the below rejection for claim 23.

Regarding claim 23, Logan et al. discloses that intermediate plate (upper portion) 60 is vacuum-brazed to the heat sink base (lower portion) 70 of base plate (60, 70), but does not disclose clamping plate (42, 44, 50) as being vacuum-brazed to intermediate plate 60.

However, it is well known in the art to vacuum-braze layers or components of an electrostatic chuck to one another. Weldon et al. discloses a brazed joint 326 securing a tubular sleeve 320 to an electrode 110. See Fig. 7 and column 11, lines 65-67. Mountsier et al. discloses brazing metallic threaded inserts for holding bolts 24 to a ceramic disk 52 and brazing a ceramic disk 110 to a metallic cooling disk 112. See Figs. 2 and 22; column 4, lines 47-51; and column 16, lines 11-13. It would have been obvious to one of ordinary skill in the art at the time of the invention to vacuum-braze the clamping plate to the intermediate plate in order to permanently secure the two layers against one another and strengthen the thermal and electrical conductivity between the layers.

Regarding claim 31, Logan et al. does not specify the surface roughness of the

plurality of micro-electromechanical structures.

However, Mountsier et al. discloses the contact surface roughness of a plurality of micro-electromechanical protrusions 72 to be less than 0.05 microns and that reducing the amount of direct contact between a clamping plate 48 and wafer under process 62 is desirable. See column 9, lines 14-20 and column 10, line 1. It would have been obvious to one of ordinary skill in the art at the time of the invention to reduce the surface roughness of the micro-electromechanical structures in order to reduce contact heat conduction and reduce damage to the wafer under process.

Regarding claim 33, Logan et al. does not disclose a pressure control system.

However, Mountsier et al. discloses clamping plate 48 comprising a pressure control system 120 operable to control a backside pressure of a cooling gas residing within a plurality of gaps between a first pressure (0 Torr) and a second pressure (20 Torr), wherein a heat transfer coefficient of the cooling gas is primarily a function of the backside pressure. See Fig. 23 and column 7, lines 42-55. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the pressure control system of Mountsier et al. in order to regulate the heat transfer between the electrostatic chuck of Logan et al. and the wafer under process.

Regarding claim 35, Mountsier et al. discloses the first pressure (0 Torr) and second pressure (20 Torr) being selected such that a thermal conduction between a substrate 62 and clamping plate 48 through the cooling gas is in a free molecular regime, wherein the heat transfer coefficient of the cooling gas is primarily a

function of the backside pressure and is substantially independent of the gap between substrate 62 and clamping plate 48. See Fig. 7 and column 7, lines 14-17 and 42-55.

Regarding claim 36, Mountsier et al. discloses one or more gas distribution grooves 74 associated with top surface 52 of clamping plate 48 thereof, one or more gas distribution grooves 74 extending a third distance D_C into clamping plate 48, wherein the third distance D_C is substantially larger than the first distance H_D, and wherein each of the one or more gas distribution grooves 74 intersects one or more of the plurality of gaps between protrusions 72, such that a cooling gas flowing in a viscous regime is operable to occur therethrough, thereby allowing a cooling of the substrate 62 to be quickly initiated. See Figs. 10a and 11b. Fig. 10a shows gas distribution grooves 74 intersecting the gaps between protrusions 72, and gas distribution groove 74' encircling the surface 52 along the outer edge. Fig. 11b shows groove 74' extending a third distance D_C into clamping plate 48, wherein the third distance D_C is substantially larger than the first distance H_D. Although it is not shown in the figures, it can be inferred that the depth of grooves 74 is equal to the depth D_C of groove 74'.

Regarding claim 37, Mountsier et al. discloses a gas conduit 110 fluidly coupled between pressure control system 120 and at least one of one or more gas distribution grooves 74, wherein gas conduit 110 is operable to permit a range of backside pressures of the cooling gas within the plurality of gaps between protrusions 72 in response to pressure control system 120. See Figs. 4, 10a, 11b, and 23; column 7, lines 56-65; column 12, lines 66-67; and column 13, lines 1-18.

Regarding claim 38, Mountsier et al. discloses one of the plurality of protrusions on surface 52 comprising a ring 78 having a diameter, wherein the diameter of the ring is slightly smaller than a diameter of substrate 62, and wherein ring 78 is generally concentric with substrate 62 and configured to generally provide a seal between clamping plate 48 and substrate 62, therein defining an internal region of clamping plate 48, wherein the cooling gas residing in the internal region of 48 clamping plate is generally isolated from an external environment. See column 12, lines 5-22.

Regarding claim 39, Mountsier et al. discloses that it is desirable to remove 80-98% of the surface area of the top surface 52 that is in direct contact with substrate 62. The remaining surface area for contact heat conduction is that of protrusions 72, therefore a ratio of the protrusion contact area 72' to a surface area of the substrate 62 is about 0.1 or more. See column 9, lines 29-46.

Regarding claim 41, Logan et al. does not numerically specify the first distance. Mountsier et al. discloses that it is desirable to keep a first distance H_D (height of protrusions 72) between 20 and 35 microns. It would have been obvious to one of ordinary skill in the art at the time of the invention to change the first distance to an optimum value according to the material of the wafer under process, the voltage applied to the electrodes, the gas pressure within the chuck, etc. since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 717 F.2d 272, 205 USPQ 215 (CCPA 1980).

31. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) as applied to claim 1 above,

and further in view of Anderson et al. (US 5,583,736). Logan et al. does not disclose the plurality of protrusions (42, 46) to comprise silicon dioxide.

However, Anderson et al. discloses an electrostatic chuck with a plurality of protrusions 19 made of silicon dioxide. See Fig. 1 and abstract. It would have been obvious to one of ordinary skill in the art at the time of the invention to from the plurality of protrusions of Logan et al. out of silicon dioxide in order to maintain high thermal conductivity in the protrusions at simultaneously avoid adhesion.

32. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) as applied to claim 1 above, and further in view of Nakajima (US 6,452,775). Logan et al. does not disclose the plurality of portions of first electrically conductive layer 45 to be generally electrically isolated from one another by silicon dioxide.

However, Nakajima discloses using silicon dioxide as an insulator (see abstract). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use silicon dioxide to isolate the plurality of portions of the first electrically conductive layer in order to provide an electrical separation while at the same time using a material consistent with several layers in the chuck.

33. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Weldon et al. (US 6,414,834) and Mountsier et al. (US 5,810,933) as applied to claim 33 above, and further in view of Rossman et al. (US 6,077,357). Neither Logan et al. nor Mountsier et al. specify the first distance (the

height of the protrusions) to be less than or about equal to the mean free path of the cooling gas.

However, Rossman et al. discloses that the gap between an electrostatic chuck 104 and substrate 182 should be less than the mean free path of the cooling gas. See column 10, lines 66-67 and column 11, lines 1-10 and 26-30. It would have been obvious to one of ordinary skill in the art at the time of the invention to make the first distance (the height of the protrusions or the depth of the gap between the protrusions) less than or equal to the mean free path of the cooling gas in order to have optimum heat transfer and prevent heat transfer gas molecules from flowing through the gaps, which causes plasma generation or ionization damage to the chuck.

34. Claims 42-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Logan et al. (US 5,155,652) in view of Rossman et al. (US 6,077,357) and Mountsier et al. (US 5,810,933).

Regarding claim 42, Logan et al. discloses a method of clamping a substrate (not shown, see column 2, lines 56-57) and controlling a heat transfer associated therewith, the method comprising: placing the substrate on a surface 44 having a plurality of protrusions (42, 46) extending therefrom, the plurality of protrusions defining a plurality of gaps therebetween and a first distance between the substrate and surface 44; and applying a voltage between at least two regions of surface 44, wherein an electrostatic force generally attracts the substrate to surface 44. See Fig. 1; column 2, lines 54-68; and column 3, lines 1-3. Logan et al. does not disclose the first distance as being associated with a mean free path of a cooling gas within the gaps or controlling a

pressure of the cooling gas in the gaps, wherein a heat transfer coefficient of the cooling gas within the gaps is primarily a function of pressure and substantially independent of the gap distance.

However, Rossman et al. discloses that the gap between an electrostatic chuck 104 and substrate 182 should be less than the mean free path of the cooling gas. See column 10, lines 66-67 and column 11, lines 1-10 and 26-30. It would have been obvious to one of ordinary skill in the art at the time of the invention to make the first distance (the height of the protrusions or the depth of the gap between the protrusions) associated with the mean free path of the cooling gas, specifically less than the mean free path of the cooling gas, in order to have optimum heat transfer and prevent heat transfer gas molecules from flowing through the gaps, which causes plasma generation or ionization damage to the chuck.

Additionally, Mountsier et al. discloses controlling a pressure of the cooling gas in the gaps, wherein a heat transfer coefficient of the cooling gas within the gaps is primarily a function of pressure and substantially independent of the gap distance. See Fig. 23 and column 7, lines 42-55. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the pressure control system of Mountsier et al. in order to regulate the heat transfer between the electrostatic chuck of Logan et al. and the wafer under process.

Regarding claim 43, Mountsier et al. discloses achieving a first pressure of the cooling gas within the gaps to achieve a first heat transfer coefficient; and achieving a second pressure of the cooling gas that is greater than the first pressure within the gaps

to achieve a second heat transfer coefficient that is greater than the first heat transfer coefficient. See Fig. 9 and column 7, lines 30-50. The reference discloses achieving multiple pressures in multiple ranges of gas pressure limits. The graph of Fig. 9 illustrates the achievement of multiple pressures and heat transfer coefficients, where the pressure and heat transfer coefficient are positively correlated.

Regarding claim 44, Mountsier et al. discloses a wide range of pressures in the graph of Fig. 9. Both points of a first pressure at about 0 Torr and its associated first heat transfer coefficient at about 0, and a second pressure between about 100 Torr and about 250 Torr, can be seen on the graph.

Regarding claim 45, Mountsier et al. discloses the surface 52 on which the substrate 62 resides further comprising one or more gas distribution grooves 74, each of one or more gas distribution grooves 74 intersecting one or more of the plurality of gaps between protrusions 72, one or more gas distribution grooves 74 being substantially larger than the gaps such that a cooling gas flow therethrough occurs in a viscous regime, thereby allowing a cooling of substrate 62 to be quickly initiated. See Figs. 10a and 11b. Fig. 10a shows gas distribution grooves 74 intersecting the gaps between protrusions 72, and gas distribution groove 74' encircling the surface 52 along the outer edge. Fig. 11b shows groove 74' extending a third distance D_C into clamping plate 48, wherein the third distance D_C is substantially larger than the first distance H_D. Although it is not shown in the figures, it can be inferred that the depth of grooves 74 is equal to the depth D_C of groove 74'.

Regarding claim 46, Mountsier et al. discloses that controlling a pressure in the gaps between protrusions 72 comprises flowing the cooling gas through the gaps via one or more gas distribution grooves 74. The reference discloses a gas conduit 110 fluidly coupled between pressure control system 120 and at least one of one or more gas distribution grooves 74, wherein gas conduit 110 is operable to permit a range of backside pressures of the cooling gas within the plurality of gaps between protrusions 72 in response to pressure control system 120. See Figs. 4, 10a, 11b, and 23; column 7, lines 56-65; column 12, lines 66-67; and column 13, lines 1-18.

Regarding claim 47, Rossman et al. discloses applying 700V by a DC voltage source (see column 15, lines 10-14). None of the above references specify applying a voltage less than 300V.

However, it would have been obvious to one of ordinary skill in the art at the time of the invention to adjust the voltage level applied to the electrostatic chuck according to the ability of the layers in the chuck and the wafer under process to withstand high voltages and resulting heat, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 717 F.2d 272, 205 USPQ 215 (CCPA 1980).

35. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ann T. Hoang whose telephone number is 571-272-2724. The examiner can normally be reached Monday through Friday, 8:00 a.m. to 5:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Sircus can be reached at 571-272-2058. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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ATH

Phuong T. Vu
Primary Examiner